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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/824,697	04/14/2004	Roger E. Welser	0717.2013-013	6799

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HAMILTON, BROOK, SMITH & REYNOLDS, P.C.
530 VIRGINIA ROAD
P.O. BOX 9133
CONCORD, MA 01742-9133

EXAMINER	
RODGERS, COLLEEN E	

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 03/29/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/824,697	WELSER ET AL.	
	Examiner	Art Unit	
	Colleen E. Rodgers	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 January 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This Office Action responds to the amendment of 30 January 2006. By this amendment, claim 5 is canceled and claims 1, 10 and 13 are amended.

Specification

2. The objection to the Specification in the Office Action dated 30 September 2006 is withdrawn in light of Applicants' amendment thereto.

Claim Objections

3. The objections to claims 10 and 13 in the Office Action dated 30 September 2006 are withdrawn in light of Applicants' amendments thereto.

4. Claim 16 is objected to because of the following informalities: in line 1, replace "latticed" with --lattice-- for consistency. Appropriate correction is required.

Claim Rejections - 35 USC § 112

5. The rejection of claim 13 in the Office Action dated 30 September 2006 under 35 U.S.C. 112, second paragraph is hereby withdrawn in light of Applicants' amendment thereto.

Claim Rejections - 35 USC § 102

6. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

7. Claims 1-4 are rejected under 35 U.S.C. 102(e) as being anticipated by **Chang et al** (USPN 6,765,242 B1).

Regarding claim 1, **Chang et al** discloses a method of fabricating a heterojunction bipolar transistor comprising: growing a base layer comprising gallium, indium, arsenic, and nitrogen [see col. 1, lines 13-18] over an n-doped GaAs collector [see col. 2, lines 17-28] from a gallium, indium, arsenic and nitrogen source, wherein the base layer is p-doped with carbon from an external carbon source [see col. 9, lines 46-49] to thereby have a carbon dopant concentration in a range between about 1.5×10^{19} cm^{-3} to about 7.0×10^{19} cm^{-3} [see col. 9, lines 46-49]; and growing an n-doped emitter layer over the base layer [see col. 2, lines 13-17].

Regarding claim 2, **Chang et al** discloses that the external carbon source is CCl_4 [see col. 9, lines 46-49].

Regarding claim 3, **Chang et al** discloses that the gallium source is trimethylgallium (TMGa) [see col. 8, line 23].

Regarding claim 4, **Chang et al** discloses that the nitrogen source is dimethylhydrazine (DMHy) [see col. 8, line 24].

Claim Rejections - 35 USC § 103

8. Claims 5-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Chang et al** (USPN 6,765,242 B1) in view of **Specht et al** (US Patent Application Publication 2005/0020033 A1).

Regarding claim 5, the prior art of **Chang et al** discloses the method of claim 4 as described above. **Chang et al** does not disclose that the ratio of the arsenic source to the gallium source is about 2.0 to about 3.5. **Specht et al** discloses an As/Ga ratio "greater than about 1.0" [see paragraph 0039]. These claims are *prima facie* obvious without a showing that the claimed ranges achieve unexpected results relative to the prior art ranges. See *In re Huang*, 40 USPQ2d 1685, 1688

(Fed. Cir. 1996) (claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art in general conditions is obvious).

Regarding claims 6 and 7, **Chang et al** further discloses that the base is grown "generally in the range of 500 to 650°C" [see Table 1, also col. 9, lines 21-23]. This reads on both claim 6, wherein the base is grown at a temperature of less than 750°C, and claim 7, wherein the base is grown at a temperature of about 500°C to about 600°C.

Regarding claims 8 and 9, **Chang et al** further discloses that the base layer comprises a layer of the formula $Ga_{1-x}In_xAs_{1-y}N_y$, where x and y are preferably $x \geq 0.03$ and $y \geq 0.01$, and further where the values of x and y are related by $x = 3y$ [see col. 8, lines 56-65]. This reads on both claim 8, wherein the base layer comprises a layer of the formula $Ga_{1-x}In_xAs_{1-y}N_y$, wherein x and y are each, independently, about 1.0×10^{-4} to about 2.0×10^{-1}, and claim 9, wherein x is about equal 3y.

Regarding claim 10, **Chang et al** further discloses that the collector is GaAs [see col. 2, lines 26-28], the emitter is InGaP or AlGaAs [see col. 2, lines 23-26] and the transistor is a double heterojunction bipolar transistor [see col. 1, lines 13-18].

Regarding claims 11 and 12, **Chang et al** further discloses the step of growing an n-doped first transitional layer over the collector and disposed between the base and the collector, wherein the first transitional layer has a graded band gap or a band gap that is smaller than the band gap of the collector. Further, the first transitional layer comprises InGaAs or InGaAsN [see col. 2, lines 41-63].

Regarding claim 13, **Chang et al** further discloses the step of growing a second transitional layer over the base, wherein the second transitional layer has a first surface contiguous with a surface of a first surface of the base and a second surface contiguous with a surface of the emitter, and wherein the second transitional layer has a doping concentration at least one order of magnitude less than the doping concentration of the emitter [see paragraph bridging columns 2 and 3, wherein the doping concentration of the second transitional layer is given as $5x10^{12}$ cm^{-2} and Table 1, wherein the doping concentration of the emitter is given as $7x10^{17}$ cm^{-3}].

Regarding claim 14, the second transitional layer is GaAs [see col. 3, lines 2-8; where x = 0, $Al_xGa_{1-x}As$ becomes GaAs]. It would have been obvious to one skilled in the art at the time of invention to use a constant or step GaAs transition in place of the graded (Al)GaAs transition. One would have been motivated to do so because binary compounds are more stable than tertiary compounds and also in order to simplify manufacturing while still getting some benefit of transition effect.

Regarding claim 15, **Chang et al** further discloses that the first transitional layer, the second transitional layer, or both the first and the second transitional layer have a doping spike, or are δ-doped [see col. 2, line 41 through col. 3, line 8].

Regarding claim 16, **Chang et al** further discloses the step of growing a lattice-matched layer over the collector (or GaAs substrate), wherein the lattice-matched layer has a first surface contiguous with a first surface of the collector and a second surface contiguous with a second surface of the first transitional layer [see col. 1, lines 64-67; see also Table 1, and col. 8, lines 44-49].

Regarding claim 17, **Chang et al** does not disclose a lattice-matched layer of InGaP. It would have been obvious to one skilled in the art at the time of invention to further include a InGaP lattice-matched layer so that the emitter-base junction would be symmetric to the base-collector

junction, thereby enabling the structure to be selectively used as either a top emitter or as a bottom emitter device, which is a well known desire in the industry.

Response to Arguments

9. Applicants' arguments filed 30 January 2006 have been fully considered but they are not persuasive. Applicants assert that the disclosed range of 10^{18}-10^{20} cm^{-3} in **Chang et al** is insufficient to anticipate the instantly claimed range of 1.5 x 10^{19} to 7.0 x 10^{19}. However, in the absence of evidence of unexpected results relative to the prior art range, Examiner considers the disclosure of **Chang et al** to be anticipatory to the instantly claimed range.

Applicants further assert that there is no suggestion in **Chang et al** of carbon dopant concentration in a range of between about 1.5 x 10^{19} to about 7.0 x 10^{19}, but rather only demonstrates that an InGaAsN base layer having a carbon dopant concentration of 1 x 10^{19} cm^{-3} was achieved. However, **Chang et al** considers the disclosure of Table 1 to be exemplary of their disclosure [see col. 7, lines 61-63], and therefore is not considered limiting by the Examiner.

Furthermore, Applicants assert that the prior art of **Chang et al** does not disclose or suggest that an HBT having an InGaAsN base layer that is heavily carbon doped in a range of between about 1.5 x 10^{19} to about 7.0 x 10^{19} can result in low base sheet resistivity, good electron mobility across the base layer and high collector current gain. However, the prior art reference cited is not required to have been attempting to gain the same benefit from the claimed feature as has been disclosed in the instant specification. Additionally, that **Chang et al** discloses a dc collector gain of only 23 in an exemplary measurement is not evidence that Applicants have provided an unexpected result with the claimed range. The dc collector gain appears to be a result-effective variable, and will vary with routine optimization, absent evidence to the contrary. Therefore, the Examiner disagrees

that the prior art of **Chang et al** does not at least render obvious the instantly claimed range, if not anticipatory to said range.

Finally, Applicant asserts that the prior art of **Specht et al** does not overcome the deficiency of **Chang et al** with respect to the claimed carbon dopant concentration. Examiner disagrees that the prior art of **Chang et al** requires any modification to anticipate the instantly claimed range, rendering the argument with respect to **Specht et al** moot.

Conclusion

10. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Colleen E. Rodgers whose telephone number is (571) 272-8603. The examiner can normally be reached on Monday through Friday, 9:00 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CER

CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800